

Environmental Impacts of Beach Nourishment: Lessons from South Carolina

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The Big Question

- How sustainable is beach nourishment?

Economically

Socially

Geologically

Ecologically



- What is the physical and biological impact to our resources?

Beach

Surf zone and nearshore

Borrow area

Beach Impact Concerns

- **Physical**
 - Profile**
 - Beach compatible sand**
- **Biological**
 - Plant habitat (dunes)**
 - Turtle nesting**
 - Shorebird nesting, foraging, overwintering**
 - Invertebrates**
 - Infauna**
 - Burrowing macrofauna**

Nourishment Can Be Beneficial

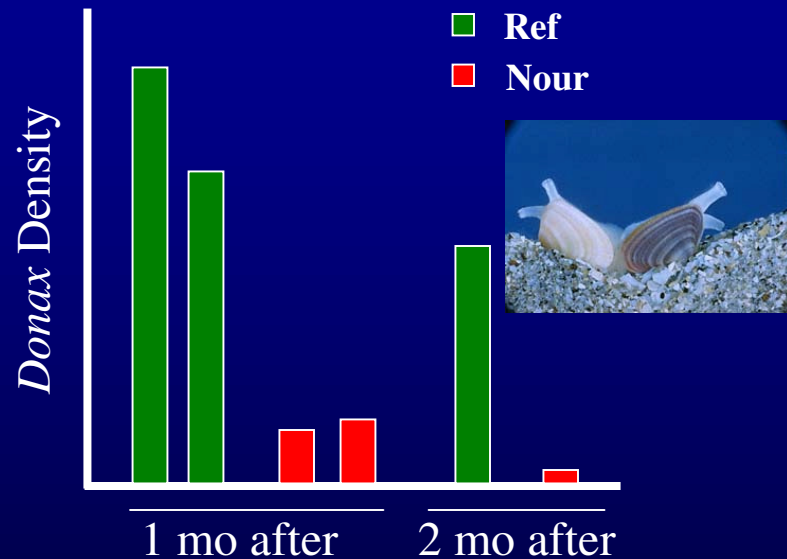
Restoration of beach profile and dunes can benefit endangered and threatened sea turtles, birds and plants.



Nourishment Can Be Harmful

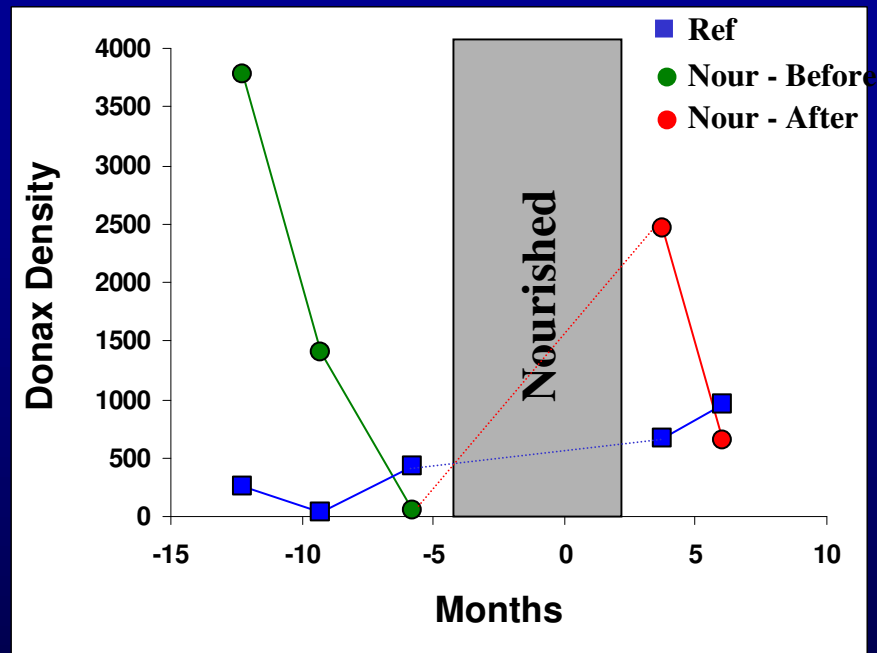


Impacts May Be Short-term



**Rapid reduction of
Donax and *Emerita* on
beach**

Peterson et al (2000) J. Coast. Res. 16:368-78



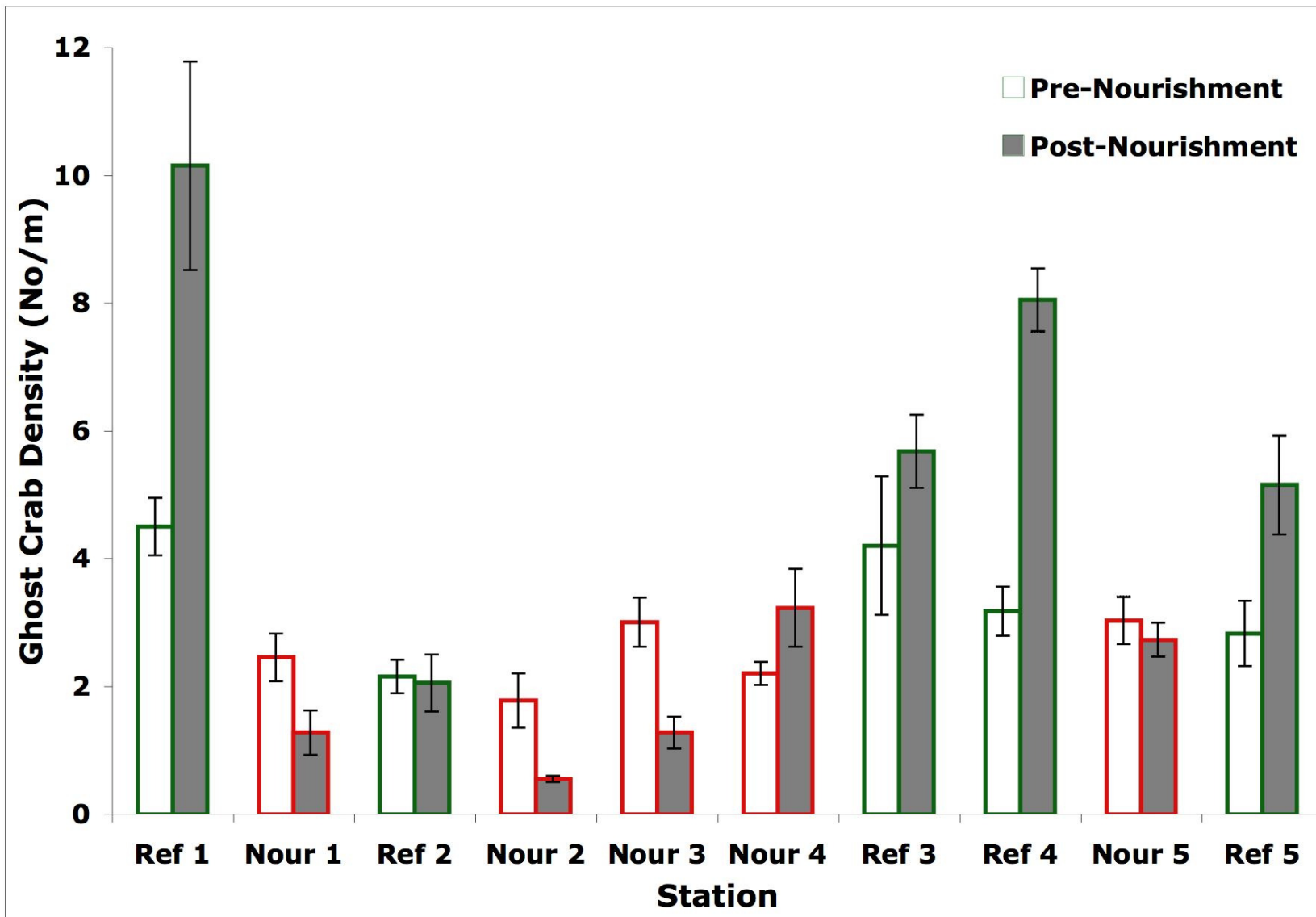
**Longer-term—natural
variability dominates**

Jutte et al (1999) Techn. Report

Impacts May Be Longer-term

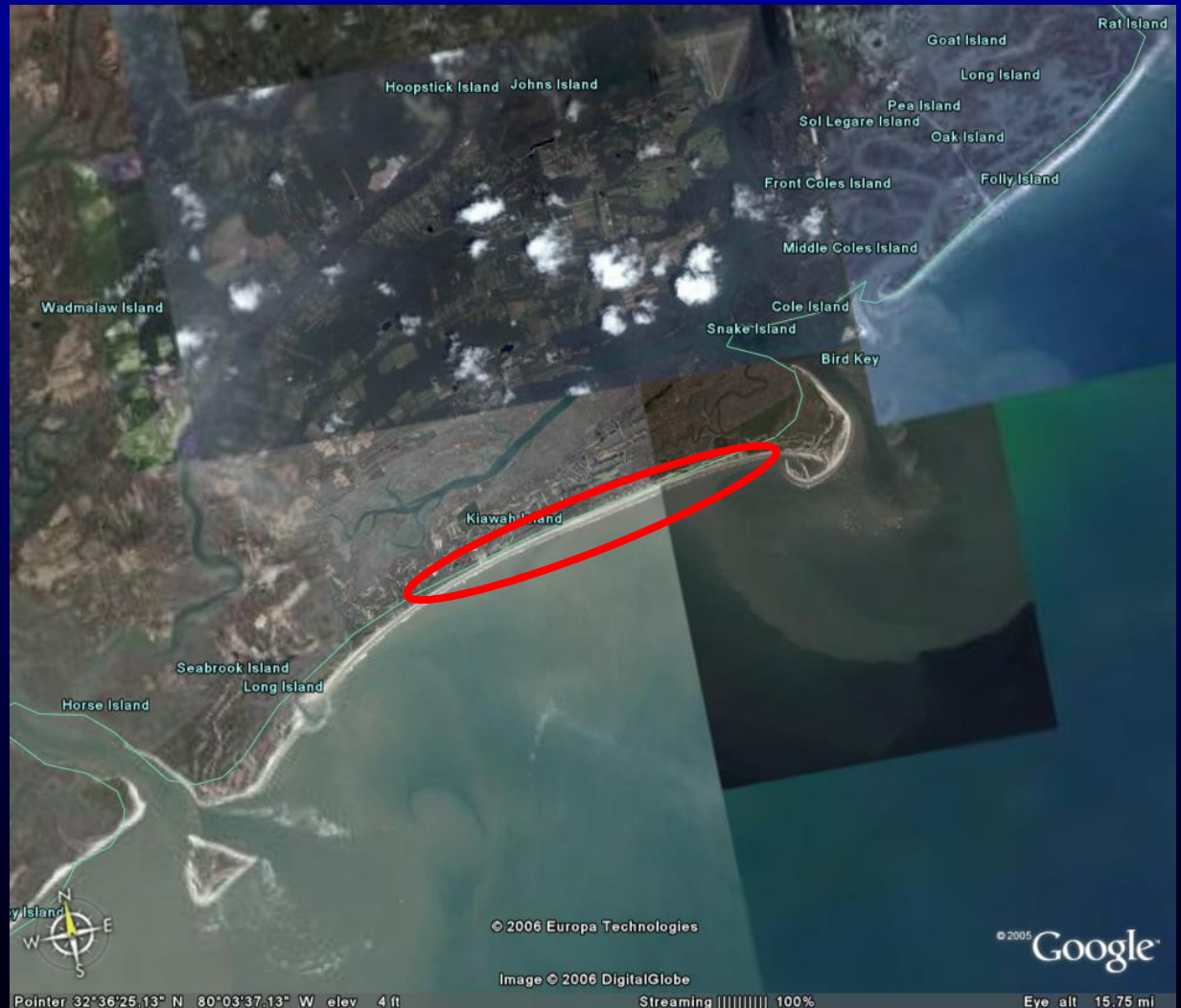


Impacts May Be Longer-term

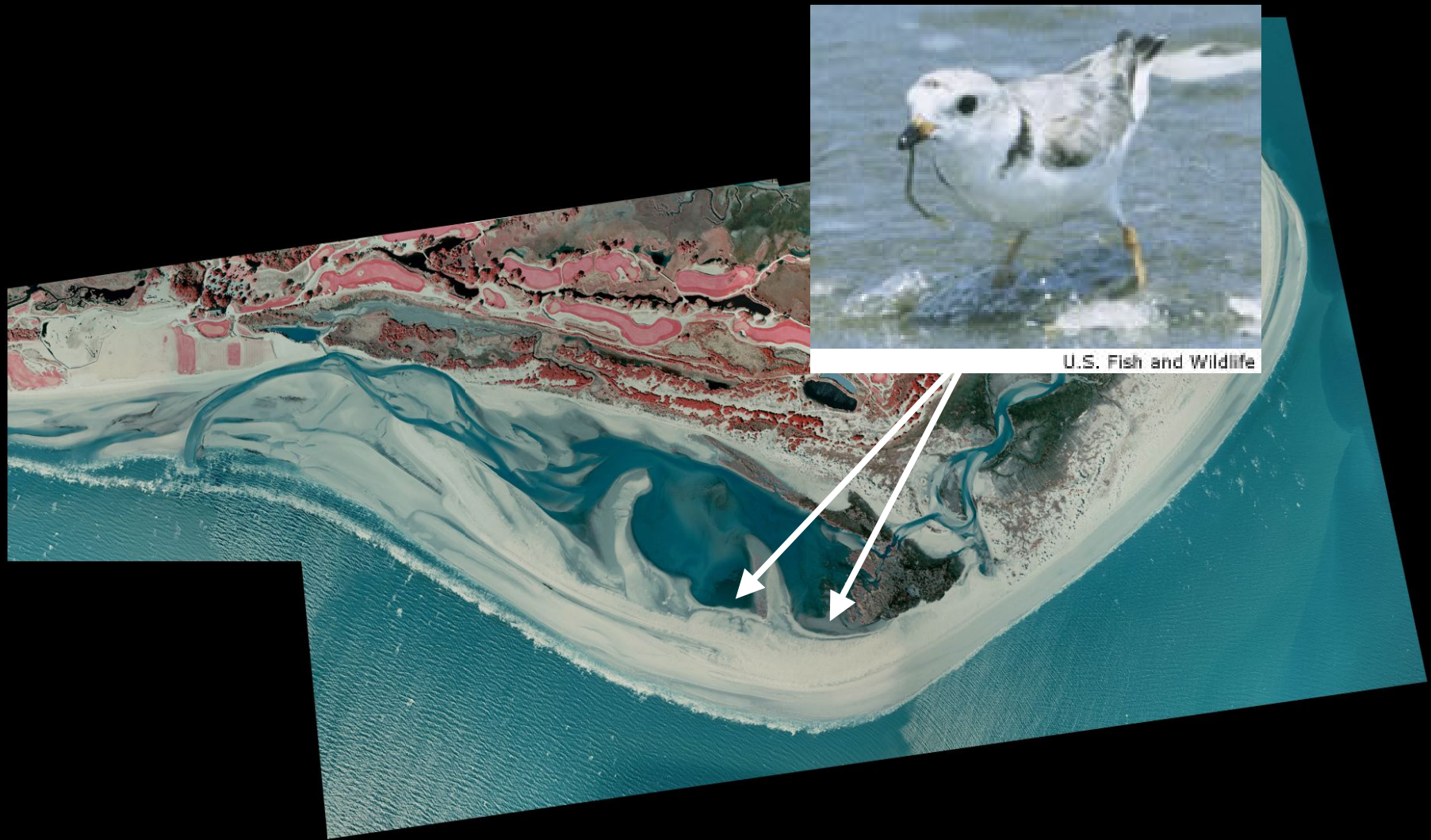


Dynamic and Unpredictable

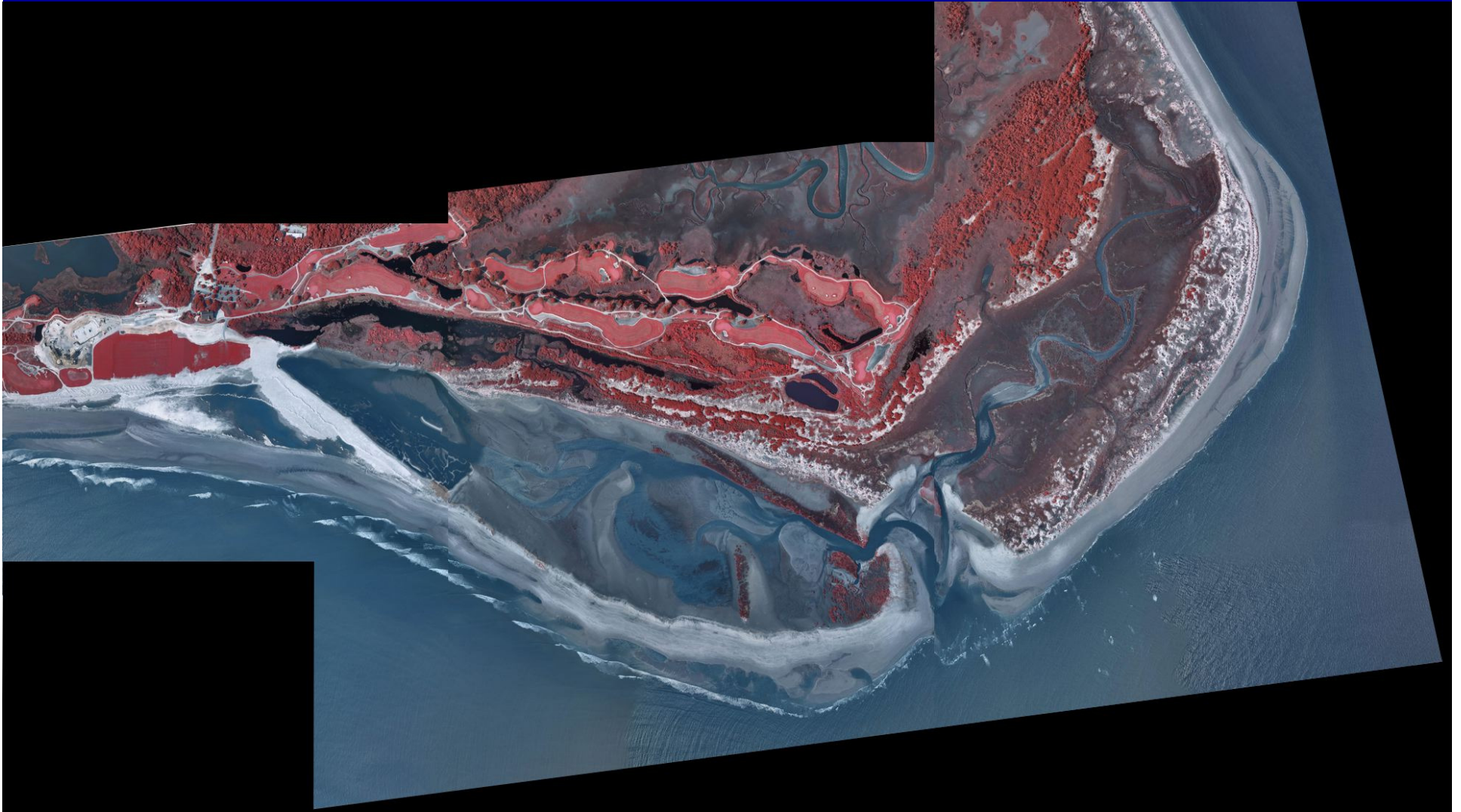
Severe ongoing erosion of east end of Kiawah Island



Dynamic and Unpredictable



Dynamic and Unpredictable



Dynamic and Unpredictable



Lessons From The Beach

- 1. New habitat can be created or degraded habitats restored**
- 2. Placement of sand partially or fully buries macrobenthic community**
 - Recovery can be rapid**
- 3. “Impact” depends on indicator examined**
- 4. Minimum impact tied to good sediment match**
- 5. Beaches and nourishment projects are at mercy of natural forces**
- 6. Many effects still not well understood**

Nearshore Impact Concerns

- **Physical**

 - Turbidity**

 - Sediment transport**

- **Biological**

 - Fish**

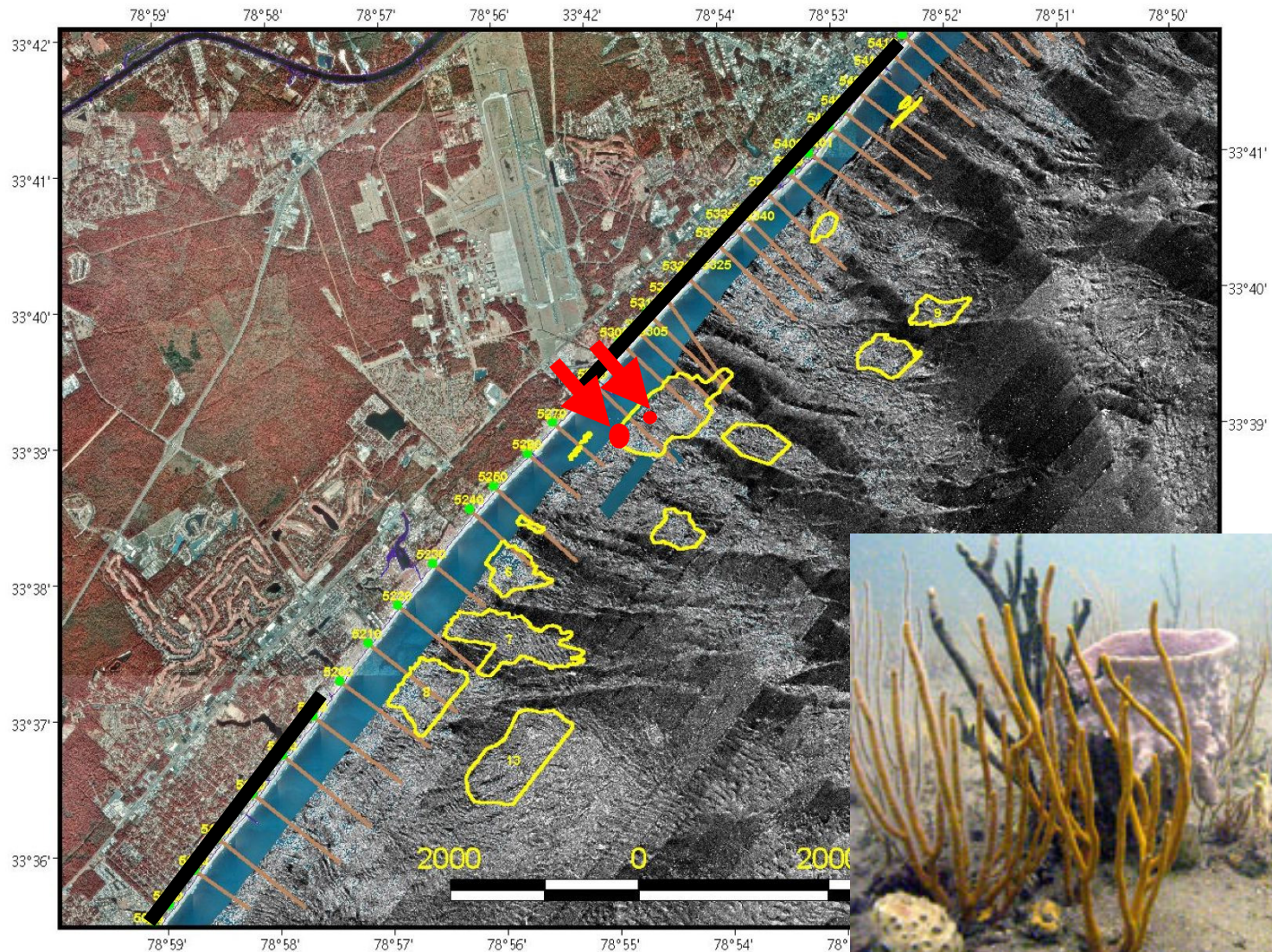
 - Invertebrates**

 - Infauna**

 - Epibenthic fauna**

 - Habitat**

Nearshore Habitat



Nearshore Impacts in a Nutshell

1. Turbidity plume short-lived

Biological response temporary and species-specific

2. Burial of nearshore habitat possible

3. Impacts still understudied

Borrow Area Impact Concerns

- **Physical**

- Refilling of dredge pit**

- Recover of sediment characteristics**

- Damage to surrounding habitats**

- **Biological**

- Turtles**

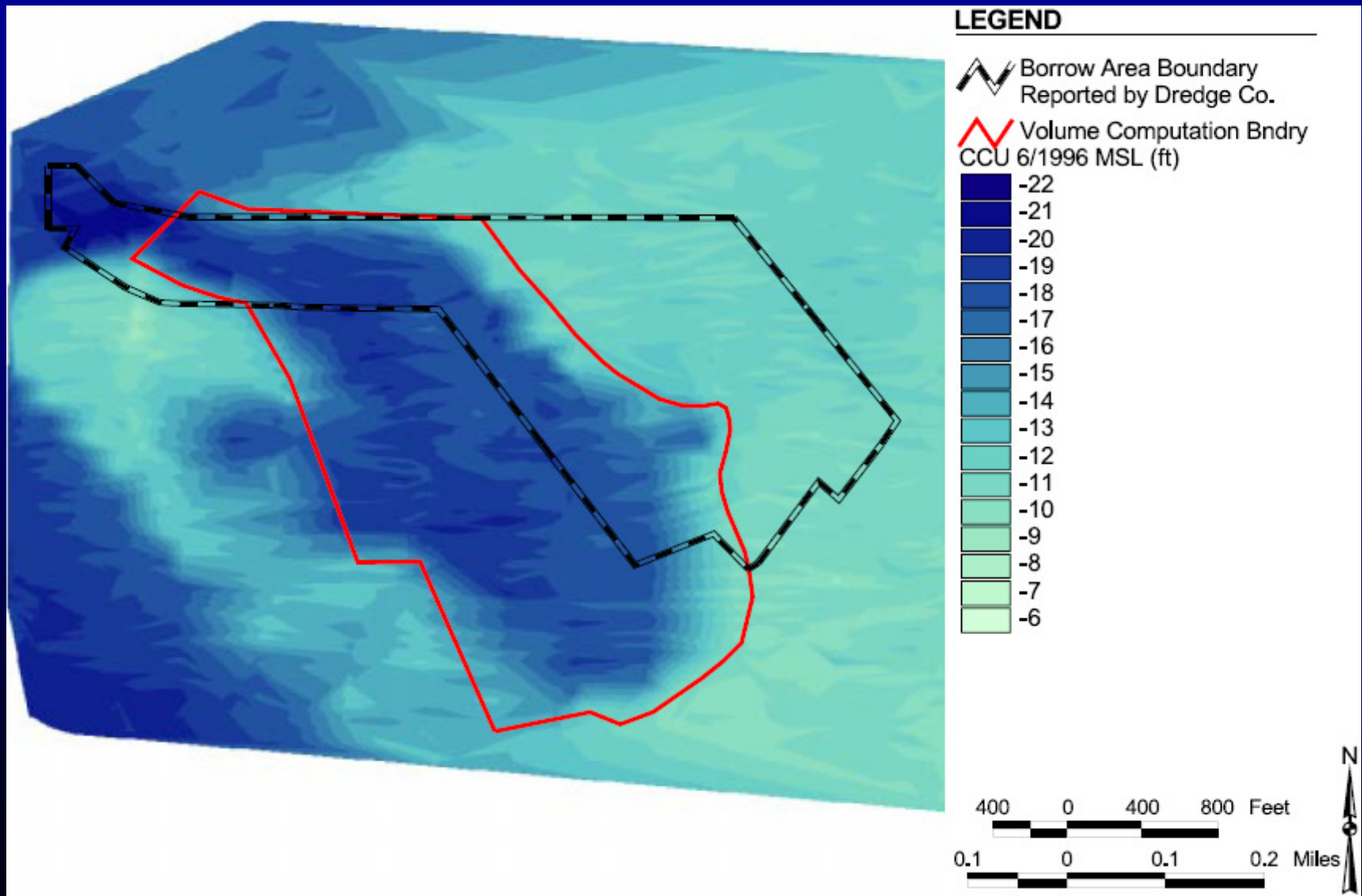
- Fish communities**

- Invertebrates**

- Infauna**

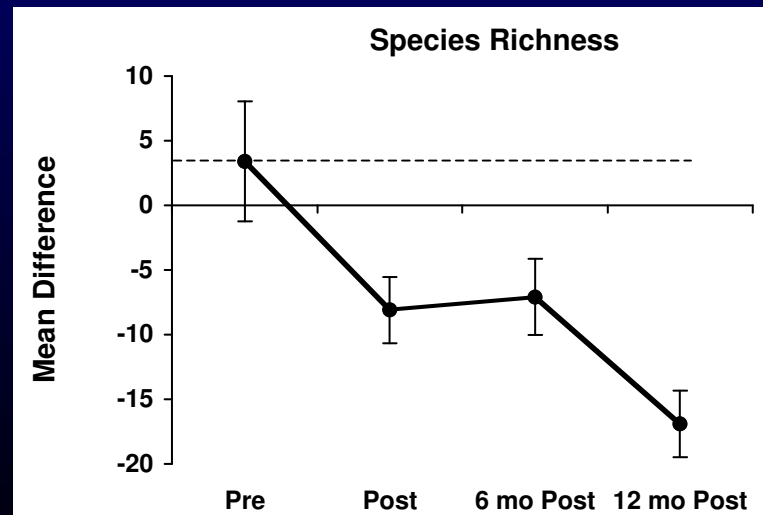
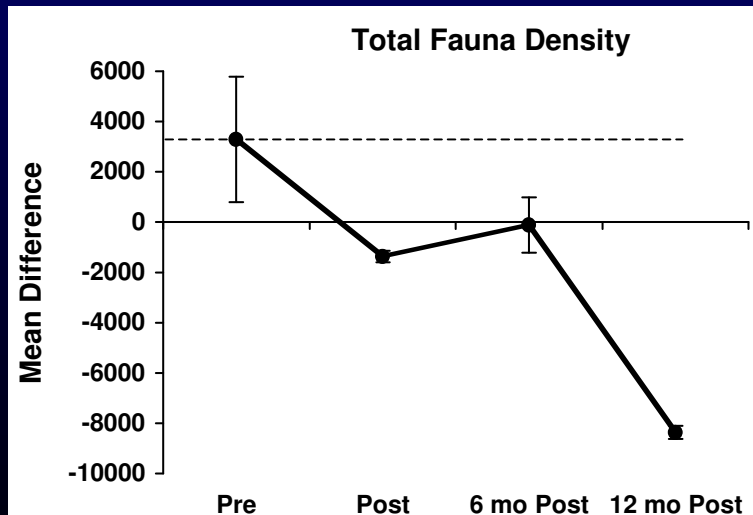
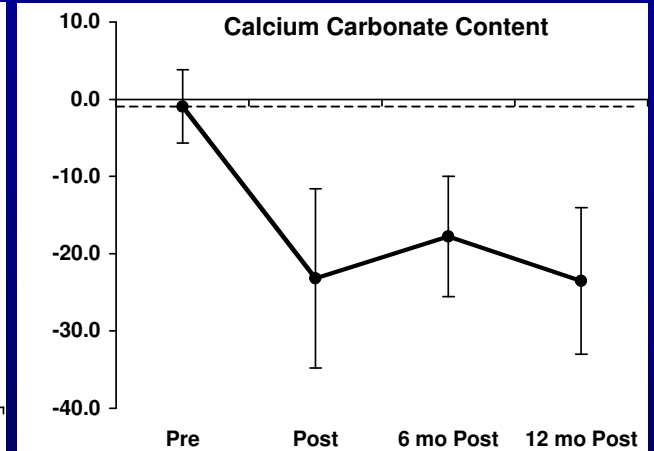
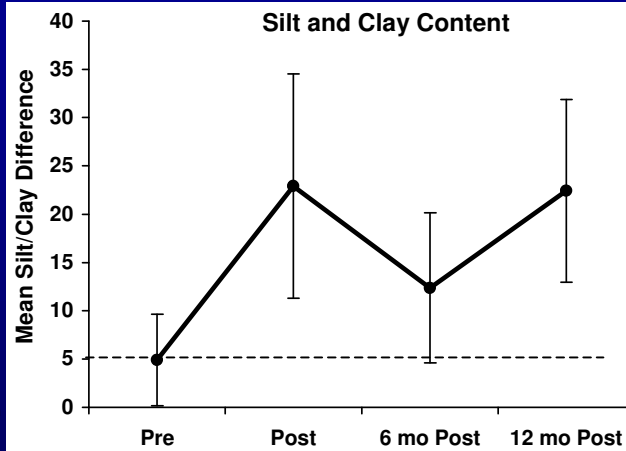
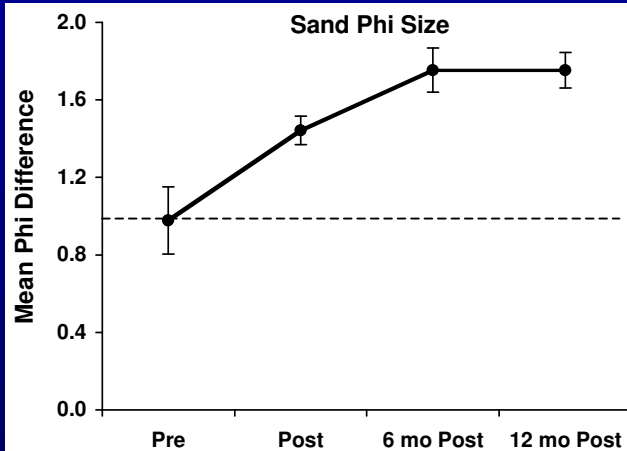


Hilton Head 1994

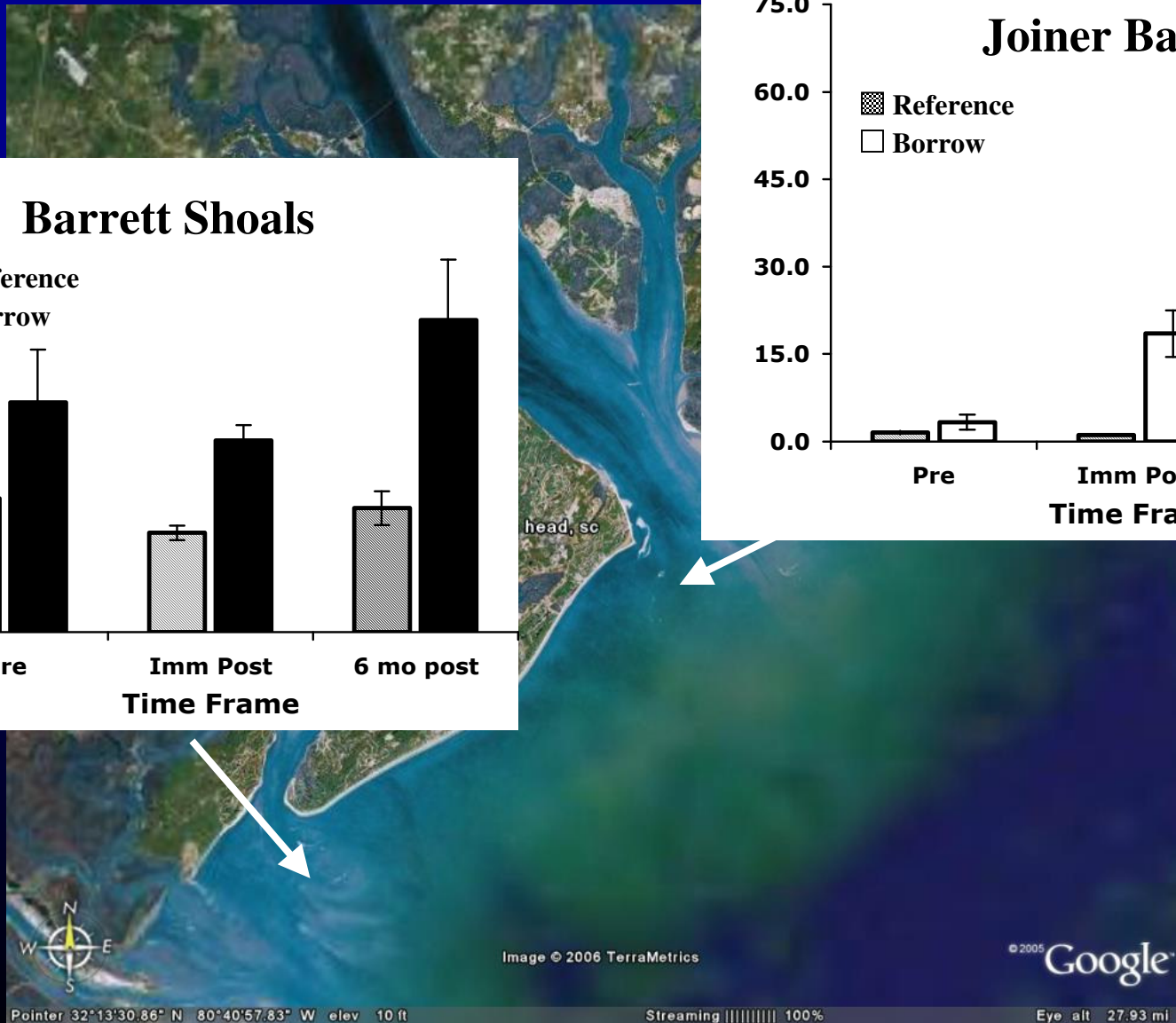
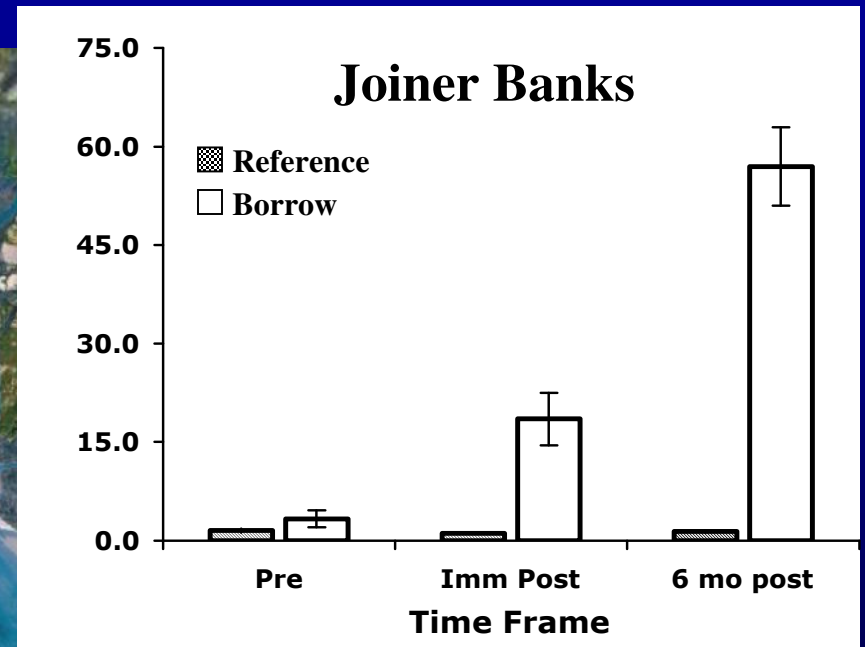
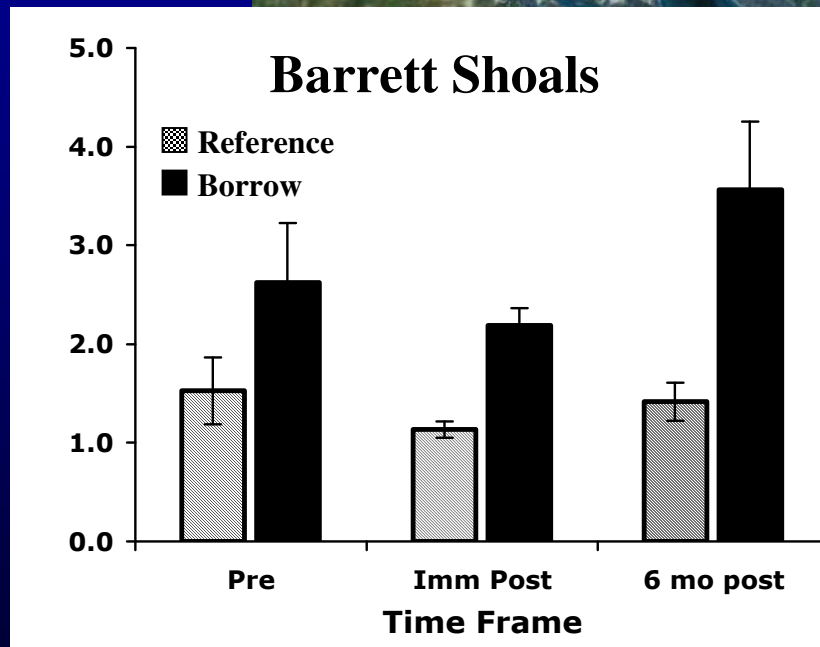


Impact on Sediment and Fauna

Folly Island -- 2005

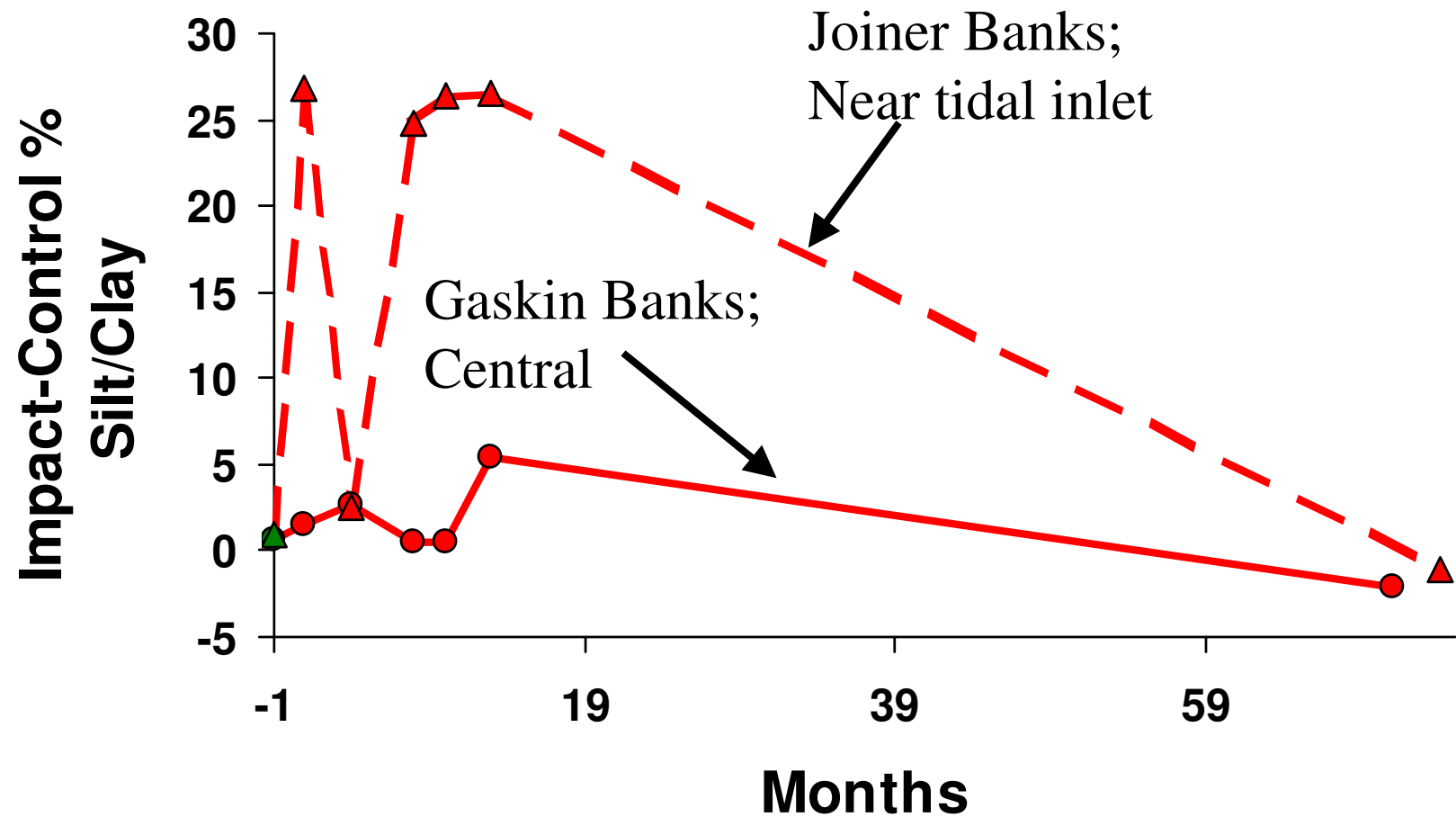


Sediments and Project Design



Sediments – Recovery?

Hilton Head



Bird Key



Borrow Area Lessons

- 1) Sediment characteristics can fail to recover**
- 2) Biological communities can fail to recover**
- 3) Depth of dredge pit below grade and proximity to tidal inlets important**
 - May result in inability to reuse later**
- 4) Nearby bathymetric high features susceptible to harm**

Variability and Disagreement

- “Impact” is a relative term
 - Little/no to substantial physical change
 - Rapid to slow physical or biological recovery times
- Sources of variation
 - Project details
 - Assessment methods
 - Targeted resource
 - Environmental settings
 - Statistical problems
- Monitored Nourishment Projects:
 - Hilton Head: 1990, 1997, 2007 (ongoing)
 - Folly Beach: 1993, 2005, 2007 (ongoing)
 - Myrtle Beach: 1994, 2007 (ongoing)
 - *Others: Edisto, Seabrook, Debordieu, etc.*

Nourishment Meta-Analysis Project

Major Goals:

- 1) Centralize reports and data
- 2) Identify consistent physical and biological impacts
- 3) Develop empirically-defensible permitting conditions
- 4) Improve and standardize monitoring protocols

Project Components:

Library
Database
Meta-analysis
Recommendations



Meta-Analysis Approach

Philosophy:

Treat each assessment as a single observation/experiment

For Each Study:

1. Calculate pre vs post change at impact site and at reference site

2. Calculate effect size (Hedge's d)

Roughly, difference in change between impact and reference

0 = no difference

+ = elevated at impact

- = depressed at impact

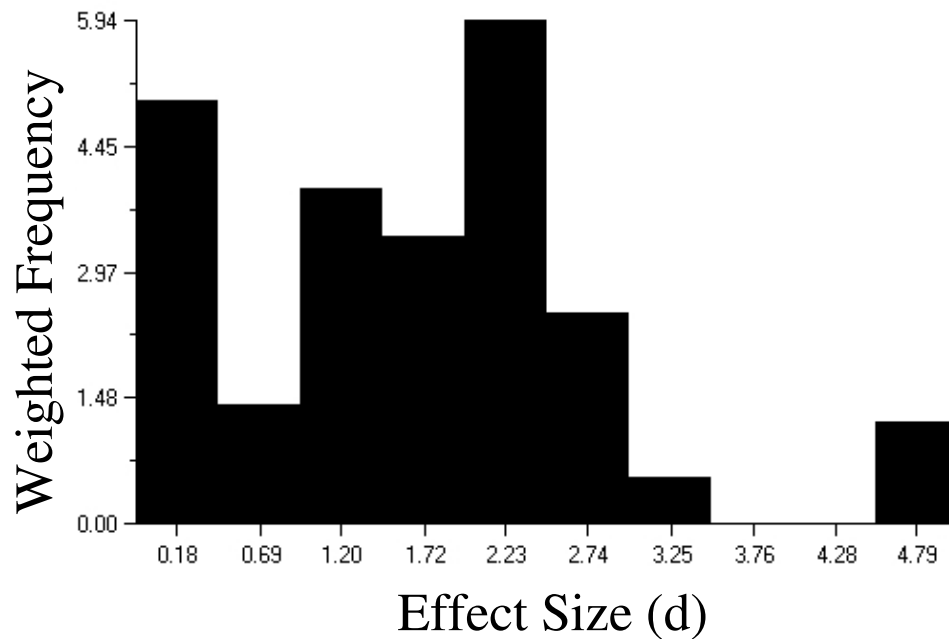
Example Meta-Analysis

Preliminary Analysis:

9 Borrow Areas

Silt/Clay Content

Pre-dredge vs ~1mo Post-dredge



Effect Size = 1.7423

95% CI = (0.95, 2.62)

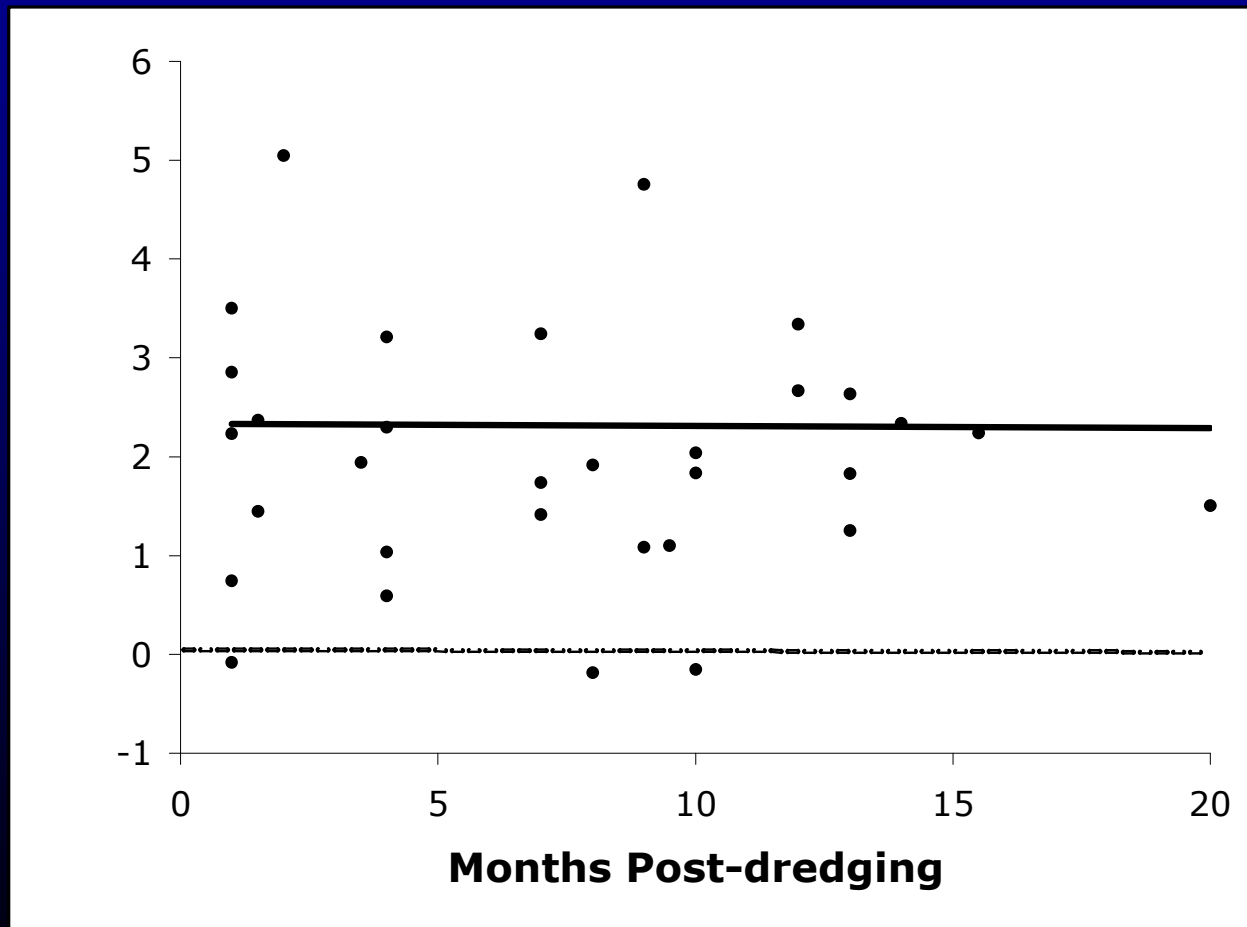
A Deeper Look at Effect Size

Inlet Effects

	Near Inlet/ North Island End	Away from Inlet/ South Island End
Effect Size	3.00	1.19
95% CI	(2.30, 4.56)	(0.33, 2.01)

A Deeper Look at Effect Size

Recovery:



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